FY15 Research & Development

Summaries & Staff Recommendations – January 2015

The Commission received thirteen new proposals for R&D funding by the October deadline. The Committee will meet January 12th to make decisions on which of these will be sent to the vetting process.

Req #	Organization Name	Project Title	Request Amount	Staff recommends
2978	CML Recycling	Pyrolysis of Waste Agricultural Scrap in Southern Virginia	$500,000	**No further action**
2987	Dan River Business Development Center	Mid-IR Fiber Optic Research, Development and Commercialization Facility	$1,500,000	**Send to vetting**
2989	City of Danville	EcomNets - Intuition- Cyber Security Analytics	$1,999,999	**No further action**
2986	Floyd County EDA	Phase II: Advanced Nonwoven Filtration to Save Air, Energy and Lives	~~$2,000,000~~ $1,500,000	**No further action**
2988	Greensville County	Development of Novel Weed and Moisture Control Mat for Tree Protection	~~$2,000,000~~ $720,000	**No further action**
2981	Halifax County IDA	Development and Commercialization of an Autonomous Water Vehicle in Southern VA	$1,695,314	**Send to vetting**
2984	Institute for Advanced Learning and Research	Package Innovation and Development Center	$1,997,033	**Send to vetting**
2983	Institute for Advanced Learning and Research	Development of High Oil Biomass	$388,219	**Send to vetting**
2980	Region 2000 Research Institute	5th Generation Nanoseptic Surfaces	$2,000,000	**Send to vetting**
2979	Region 2000 Research Institute	Critical Communications Voice & Data Interchange System (CCVDIS)	$904,372	**No further action**
2985	Southwest Virginia Higher Education Center Foundation	Smart Packaging and Predictive Analytics to Reduce Abuse of Prescription Opioids	$375,000	**No further action**
2982	Southwest Virginia Higher Education Center Foundation	Low cost, high pressure, hydrogen storage vessel using steel wire overwrap (WireTough Phase 2)	$2,000,000	**Send to vetting**
2977	Washington County Industrial Development Authority	Hermetically Sealed Epoxy Power Terminal for Electrical Equipment	$722,590	**No further action**
		Total (13 requests)	**$18,082,527**	

CML Recycling
Pyrolysis of Waste Agricultural Scrap in Southern Virginia (#2978)
$500,000 requested

Executive summary provided by applicant: A pyrolysis plant to be set up in Southside Virginia in a median location, so as to service all 9 counties in the region. This will reduce logistics cost and increase adoption rates of the program. Plastic agricultural scrap as well as other non-recyclable plastic waste will be collected at drop-off sites in each county and returned to the central plant for conversion. Conversion of agricultural plastic scrap and non-recyclable plastic scrap (i.e. waste tires) will be performed using pyrolysis. The resultant fuel or crude oil will be sold at a discount to program participants, or on the secondary market.

Research and Development Opportunity

This project will determine the feasibility of larger scale pyrolysis projects and the potential benefits of utilizing a resource currently bound for landfills. The return, at a lower cost to regional farmers, as diesel fuel will also create a positive economic benefit for the community. It is up to the project to determine and procure the most efficient, lowest priced machinery available. Our ultimate goal will be to determine the effectiveness and acceptability of biofuel use and landfill conservation in the Southern US using pyrolysis as a means for waste-to-fuel resource recovery.

Proof of Concept

Pyrolysis is already being heavily used in China and other parts of the globe. This pilot project is intended to show the acceptance, cost effectiveness and environmental benefits of a similar paradigm shift in the United States.

Proposed Research and Development

We intend to start with a pilot study, determine the current technologies effectiveness and its potential for implementation throughout Virginia and eventually the Southern, US. Issues we are concerned with are conversion rates per resin type, potential for pollution, and cost of program.

Commercial Potential

Commercially the project has many benefits. Not only does it save regional farmers expensive landfill costs and the overtaxing of landfills with non-degradable plastic, it also provides a means for converting a waste into a lucrative commodity in the form of heating and crude oil as well as diesel fuel. The resale to farmers at a lower cost to market will also positively benefit the region economically.

Intellectual Foundation

CML does not currently have any IP related to pyrolysis or conversion of plastic scrap into fuel.

Staff comments and recommendation: The applicant is working with the Southern Virginia Growth Alliance to consider sites in four SoVA localities, but a preferred site is not yet known. The request appears to be for $250k of grant funds for an overall $500k project, with TICR funds to be used for equipment and site improvements. Projected outcomes include 4 jobs ($20k avg wages) and $250k capital investment in the research phase, and 16 jobs ($25k avg wages) with $250k investment in commercialization. The focus on pyrolysis of scrap plastic waste appears to have some commercial potential, based on the company's work with Stihl Corp in VA Beach. However, pyrolysis is a well-known process that has been in use for several decades, and it is unclear that the proposed research is critical to commercial start-up. A business plan was included in the proposal, but there is no anecdotal or statistical evidence provided that there is a sufficient stream of plastic waste in Southern Virginia to provide feedstock for a biofuel facility, and that waste could be collected and processed in a cost-effective business model. Absent some basic evidence that feedstocks are sufficient and that plant operation would be sustainable, an award for equipment does not seem advisable. The proposal also indicates that similar plants would be built in other areas of Virginia (Eastern Shore is mentioned) as well as neighboring states, so the commercialization payoff for the tobacco region may be a single Commission-funded plant with modest job creation and wages. Most

importantly, this request is submitted by a private, for-profit company based in Virginia beach, and absent sponsorship by an eligible governmental or non-profit entity, is ineligible for consideration in its current form. **Staff recommends no further action.**

Dan River Business Development Center
Mid-IR Fiber Optic Research, Development and Commercialization Facility (#2987)
$1,500,000 requested

Executive summary provided by applicant: IRflex Corporation has installed state-of-the-art manufacturing facility in Danville, VA, to produce and market exciting fiber-optic devices targeted to the protection of aircraft against shoulder-fired missile. Fiber-optic devices have been developed for the Department of Defense (DoD) for infrared countermeasure (IRCM). But as the government reduced its spending budget, DoD has postponed the integration of our fiber-optic devices in their IRCM programs. Now IRflex has unique fiber technology and production facility to offer emerging fiber-optic devices specifically designed for the fast growing mid-infrared sensors markets. IRflex requests an award from the Tobacco Commission to develop and commercialize new mid-infrared fibers.

Research and Development Opportunity

IRflex Corporation has the only proven fiber technology to enable the transmission of mid-infrared lasers. Mid-infrared sensor technology in the spectral range of 2-10 micron is gaining importance in process monitoring, environmental analysis, oil and gas, security/surveillance applications, and the biomedical field. The company's infrared fiber provides the only feasible technology to enable transmission of mid-infrared laser to a remote location with improved flexibility, lower cost, compactness, and enhanced ruggedness. Mid-infrared fiber technology is the preferred solution to more expensive conventional technologies that use complex and fragile packaging with free-space beam propagation through bulk optics and mirrors. The mid-infrared fiber technology is highly reliable and efficient since it has no moving parts and no precision alignment systems that are subject to vibration, shock and thermal instabilities. IRflex has the technical expertise and the production facility to develop the novel fiber-optic devices for transmission up to 10 micron.

Proof of Concept

IRflex has already developed the technology to produce high-quality mid-wavelength infrared (MWIR) fiber for transmission range 1.5-6 micron. IRflex currently offers a range of multimode and single-mode fibers with cables and connectors. There is an important need for long-wavelength infrared (LWIR) fibers in bio-chemical sensor market. IRflex must develop new LWIR fiber with transmission up to 10 micron. IRflex has already initiated the development of LWIR fiber. Preliminary results show long-wavelength transmission but the fiber loss needs to be reduced significantly. High baseline loss and absorption peaks are signs of impurities and inclusions. Improved distillation and purification techniques can be developed. Production equipment and processes will be customized and modified to improve the LWIR fiber optical properties. IRflex also develops custom fiber-optic devices: antireflective surface, fiber combiner, fiber switch, fiber imager, hollow-core fiber. IRflex will use specialized know-how and resources to transition from R&D prototypes to full scale commercial products.

Proposed Research and Development

1-IRflex will use the same glass fabrication equipment and the state-of-the-art-fiber draw tower to develop and perfect the LWIR fiber. The LWIR fiber has different properties and must be purified and fabricated with different processes but the same equipment. Experiments will be done to optimize the chemical compositions and process conditions for the LWIR fiber. 2-IRflex will develop a unique antireflective microstructure to reduce the high reflection loss at the fiber ends. Special silicon shims are etched with precise microstructure features, heated, and pressed against the fiber tips to stamp the microstructure

pattern on the fiber. 3-Fiber-optic devices with added value will be developed and commercialized: fiber switch, fiber combiner, fiber imager. 4-Hollow-core fiber will be designed and developed to transmit extremely high-power mid-infrared laser in the hollow core. Special equipment and tools will be required to pressurize the hollow core during the fiber draw and control the fiber dimensions.

Commercial Potential

The development and commercialization of new mid-infrared fibers and added-value products for the bio-chemical sensor markets and military will drive the income increase. Income projection will grow from $742 thousand in Year 1 to $3.825 million in Year 5. This will generate 25 well-paid jobs (average annual wage of $50.2 thousand) within five years from the award date and secure gainful employment opportunities to the region workforce. Steady hiring will follow with the income growth rate (1 additional employee per $150,000 income increase). IRflex uses local suppliers for day-to day operations: machine shops with CNC milling centers and turning centers for high-precision mechanical parts, electrician, plumber, hardware store, general supplies. Danville Community College has been approached for tailored technical and manufacturing training. We also look for research collaborations with the Institute of Advanced Learning Research. The grantee, DRBDC, will have state-of-the-art clean room and the acquired equipment in its facility.

Intellectual Foundation

IRflex relies on chalcogenide glass fiber technology to develop and produce mid-infrared fiber-optic devices. This is the only proven fiber technology to enable transmission of mid-infrared lasers in the 2-10 micron wavelength range. The entire manufacturing process is highly dependent upon both patented processes and specialized intellectual know-how, which are central to IRflex's ability to sustain its leadership position in the infrared industry. IRflex has negotiated a license agreement with Naval Research Laboratory for its mid-infrared fiber patents. (17 patents). The license includes 17 patents on the mid-infrared fiber fabrication technology and specialized fiber-optic devices. IRflex also has one patent and two patent applications. The intellectual property on novel fiber devices covers packaging and special use of the mid-infrared fiber for our target applications. Together, this intellectual property and unique knowhow put IRflex in a strong position to become the leading manufacturer of mid-infrared fiber products in its target markets.

Staff comments and recommendation: This is a second request from IRFlex, which received a $2 million R&D grant in 2010. Funds requested in this phase are for personnel ($894k), equipment ($345k), supplies ($216k) and contractual. This request presents a clear proof of concept from the work leading up to and through the previous phase one grant. IRFlex's work has also been strongly supported by federal military grants. The request clearly describes the additional products and markets that will be pursued in this phase. Outcomes are listed as 12 new jobs in the research phase ($60k avg) and 13 additional production jobs during commercialization ($44k avg). Outcomes in the first grant were listed as 30 new hires by 2013, but commercialization of that technology to serve military customers has been hampered by budget cuts, and current employment is less than ten. Outcomes in phase two therefore appear to overlap with the initial R&D grant as the two research phases collectively lead to commercialization, albeit now focused more on privates sector customers than military. However, there is no new taxable private capital investment listed in either phase, which is the primary shortcoming of this request and resulted in this ranking fifth in scoring. The budget is very clearly-detailed and focused on tobacco region activities. Half of the $2 million in matching funds is already approved and the other half appears likely, given the company's history of federal support. Matching funds are spread across the categories that are also requested on the Commission. A thorough business plan is provided. The company appears to be solidly rooted in the tobacco region, and while employment from phase one has not met expectations, the company shows a clear focus on new product development and new markets that could ultimately lead to the anticipated employment levels. **Staff recommends this proposal be sent to vetting.**

City of Danville
EcomNets - Intuition -- Cyber Security Analytics (#2989)
$1,999,999 requested

Executive summary provided by applicant: This project is intended to scale and commercialize a novel process of pre-emptive Cyber Intrusion Detection and Prevention (CIDP) security analytics in Information Technology (IT). The CIDP analytics is critical to deploy against new threat landscapes which are becoming more and more undetectable, innovative, and crippling. The current trend in cyber security intrusions is for the attacker to gain access to the victim's critical data information and "lay in wait" undetected for a period of 6 months and then launch an attack or mine confidential data. It takes the victim typically 3 months to recognize and respond to the attack.

Research and Development Opportunity

It has been demonstrated that the cost that an organization will incur by neglecting to install intrusion detection and prevention system analytics, which result in the loss of intellectual property, reputation, client information, and money, is far greater than the cost of EcomNets' Intuition CIDP solution. It can be an irreversible loss and far beyond re-construction. EcomNets' Intuition -- CIDP Analytics will show organizations the new ways outsiders are getting past data center defenses and how organizations can detect in advance and fix vulnerabilities in their network to prevent these attacks. These funds will be used to purchase the necessary IT equipment to produce this highly advanced CIDP software and also to continue to advance cyber security technology to ward off the relentless attacks and intrusion efforts from determined adversarial parties. Furthermore, EcomNets Inc.

Proof of Concept

EcomNets' Intuition -- CIDP Analytics enables organizations -- regardless of size, degree of cybersecurity risk, or cybersecurity sophistication -- to apply the principles and best practices of risk management to improving the security and resilience of critical infrastructure. EcomNets' Intuition -- CIDP Analytics provides organization and structure to today's multiple approaches to cybersecurity by assembling standards, guidelines, and practices that are working effectively in industry today. Moreover, because it references globally recognized standards for cybersecurity, EcomNets' Intuition -- CIDP Analytics can also be used by organizations located outside the United States and can serve as a model for international cooperation on strengthening critical infrastructure cybersecurity. EcomNets' Intuition provides a common platform to communicate requirements among interdependent stakeholders responsible for the delivery of essential critical infrastructure services. Commercial potential and we have completed Proof of Concept and ready for Commercial use.

Proposed Research and Development

EcomNets' Intuition provides a common platform to communicate requirements among interdependent stakeholders responsible for the delivery of essential critical infrastructure services. Commercial potential include:

- Sharing cybersecurity risk management requirements to an external service provider (e.g., a cloud provider to which it is exporting data).
- A critical infrastructure owner/operator, having identified an external threat
- A critical infrastructure sector may identify an initial baseline risk prevention using EcomNets' Intuition -- CIDP Analytics.

Commercial Potential

EcomNets' Intuition -- CIDP Analytics enables organizations -- regardless of size, degree of cybersecurity risk, or cybersecurity sophistication -- to apply the principles and best practices of risk management to improving the security and resilience of critical infrastructure. EcomNets' Intuition -- CIDP Analytics provides organization and structure to today's multiple approaches to cybersecurity by assembling standards, guidelines, and practices that are working effectively in industry today. Moreover, because it references globally recognized standards for cybersecurity, EcomNets' Intuition -- CIDP Analytics can also be used by

organizations located outside the United States and can serve as a model for international cooperation on strengthening critical infrastructure cybersecurity.

Intellectual Foundation

The current trend in cyber security intrusions is for the attacker to gain access to the victim's critical data information and "lay in wait" undetected for a period of 6 months and then launch an attack or mine confidential data. It takes the victim typically 3 months to recognize and respond to the attack. Ecomnets' Intuition software and service can detect the initial intrusion in a matter of hours and then alert the victim to the breach, thus creating a solution to a potential months' long problem. It has been demonstrated that the cost that an organization will incur by neglecting to install intrusion detection and prevention system analytics, which result in the loss of intellectual property, reputation, client information, and money, is far greater than the cost of EcomNets' Intuition CIDP solution. It can be an irreversible loss and far beyond re-construction.

Staff comments and recommendation: This request seeks funding for personnel ($700K), IT equipment ($851k), contractual, continuous and other costs to be used in developing pre-emptive security analytics for cyber intrusion detection and prevention. Given the constantly evolving nature of cyber crimes it is difficult to understand from the proposal what the proof of concept it, what research steps are included in this project, and what shelf life the results would have in a world where new firewalls are created and evaded on an almost daily basis. Milestones and deliverables are exceedingly vague, with detail limited to repeated use of the term "implementation." Outcomes are stated as three jobs ($60k avg) and $600k private investment in the research phase, and 50 jobs ($60k avg) during commercialization and $2.15 million private capital investment. The commercial stage private investment corresponds directly with the required matching funds shown in the budget, making it unclear whether there truly is a research phase. Furthermore, there is no justification provided for the creation of the 50 commercial-stage jobs (what types of positions/duties etc.). The two-page business plan includes general content on the vision and mission of the company but is grossly insufficient to support the request and provides no specifics on the project/service proposed to be developed. The private company in this proposal, Northern Virginia-based Ecomnets, received a $500,000 TROF in 2010 with a promise to create 160 computer manufacturing jobs and $1.7 million capital investment. The company failed to reach those targets when its plans changed to operating a data center in its building in Danville, and Ecomnets is currently making repayment of the TROF grant in annual installments. Absent a clearly-stated research question and reliable business plan for commercialization **Staff recommends no further action**.

Floyd County EDA

Phase II: Advanced Nonwoven Filtration to Save Air, Energy and Lives (#2986)

~~$2,000,000~~ requested – reduced to $1,500,000

Executive summary provided by applicant: This project continues from R&D Project 2225 which advanced the company's science in vastly improving filtration performance. Phase II will have three product tracks. The milestones will include acquisition, installation and testing of equipment, development of media for each grade and application; and validation of performance for each application. The project will create at least 10 jobs and save 29 jobs by preventing product obsolescence. These 39 jobs pay 34% above the Floyd County average. The company will provide over $2.6 million in match. Page 3 of the Business Plan has a detailed summary, excluded here due to proprietary concerns.

Research and Development Opportunity

Individuals, families, communities and nations around the world are increasingly aware of and concerned about the health dangers of air pollutants, allergens, contaminants, and pathogens. According to a World Health Organization (WHO) report, seven million people died as a result of air pollution exposure in 2012. For example, fine particular matter (2.5 nanograms, or one-millionths) is a major factor in this; it comes largely from combustion of fuels and high concentration is common in urban areas. These particulates can penetrate human lung and blood tissue leading to higher incidences of cardiovascular and lung diseases, including cancer. This company is positioned to greatly improve the effectiveness and efficiency of filtration media through R&D at the Center of Excellence in Floyd, and production at the Floyd plant. The specifics of the opportunity are sensitive information and are described in detail on pages 19-22 in the Business Plan.

Proof of Concept

Various treatments and processes were tested in Phase I to increase the performance of filtration media for three product areas. There was clear evidence that the minimum regulatory metrics for these could be met and surpassed and that the company is in a strategic position to be able to provide this superior material successfully to many manufacturers in these sectors. Much greater detail is provided on pages 7-10 in the Business Plan.

Proposed Research and Development

Conclusions and success in Phase I have pointed to equipment and some key parameters for use of that equipment for successful commercial scale production. Phase II will include acquisition and testing of that equipment, and experimenting with inputs and parameters to determine the best process and material combinations to maximize performance. Much greater detail is provided on pages 14-20 in the Business Plan.

Commercial Potential

The Business Plan delineates the company's expected incremental sales in Years 1-5 of Commercial Sales (on page 6). The estimated total market size in just one of the three product categories is over $750 million/year. Further details not included here for proprietary reasons. This investment by the company and the Virginia Tobacco Commission will vastly improve the company's competitive position and protect 29 existing jobs from market obsolescence. It will also create at least 10 new jobs. The average annual salary of these 39 positions is $36,851 per year. This company is the largest and best paying private employer in Floyd County. The average annual salary in Floyd County is $27,560, so these 39 jobs are 34% above average.

Intellectual Foundation

See pages 6-10 of the Business Plan attachment.

Staff comments and recommendation: *NOTE: this request was revised and reduced to $1.5 million as of January 6th. See additional discussion of revisions below.* The private company that will conduct this R&D is long-established in Floyd and has significant global operations. It was previously funded with a $750,000 R&D grant in 2011. TICR funds are requested entirely for new equipment, which (if approved) would have to be owned by the County EDA. Matching funds include $1.8 million of private investment in equipment and facility improvements, plus $800k of operating costs. Outcomes are listed as four new jobs created ($53k avg) in research phase and six in commercialization ($31k avg). Of those ten new jobs, eight are production associates and just two are scientists/technicians. The requested activities appear to build on the research findings from the previous grant, and outcomes appear to overlap with the initial R&D grant as the two research phases collectively lead to commercialization. A thorough business plan is provided, and the investment outcomes seem to indicate the requested equipment and matching funds will all be spent in the research phase and will enable commercialization on that equipment (i.e. there is no additional private investment indicated in the commercialization phase). That raises the question for the Commission of whether R&D funds are appropriately used to fund commercialization phase facilities, and particularly whether a total investment of $2.75 million is a desirable ROI for the creation of ten new jobs (staff also notes the Commission's capital investment exceeds the company's). This project illustrates an admittedly gray area of the R&D program objectives (where final research leads directly to commercialization), and

TICR staff is not qualified to judge the validity of the remaining research steps. This is a company with significant corporate resources that is long-established in the footprint, conducting ongoing product development for its core line of business. Whether that is an appropriate process for the R&D program to support – as opposed to using grant funds as an incentive to attract new companies - is a key question. Ultimately, however, the proposal has the afore-mentioned issues regarding limited ROI, which caused this proposal to rank at a tie for seventh in the scoring. Staff suggests that the TROF program is a more appropriate vehicle for funding this phase of commercial product development and deployment. **Staff recommends no further action.**

Note: *The company as of January 6th agreed to reduce the request by $500,000 and to refocus $400,000 of the requested TICR funds on research phase operating costs rather than long-lived equipment (now requesting $1.1M). The revised budget is better aligned to involve TICR funds in research phase costs, and now proposes a 2:1 leveraging of private versus TICR funds. Staff notes this would have affected scoring if known earlier in the staff review, and could have affected a vetting recommendation. However, TROF remains an option for this project. The applicant will speak to the revisions at the Committee meeting.*

Greensville County

Development of Novel Weed and Moisture Control Mat for Tree Protection (#2988)

~~$2,000,000~~ requested – revised to $720,000

Executive summary provided by applicant: This project will help build and resource the capability to commercially develop a novel weed and moisture control (WCMC) mat product from disposable diapers by using low-cost, environmentally benign technologies. This new technology will address two environmental problems: diapers accumulating in landfill, and increasing cost for establishment of trees and crops due to climate change. A new recycling technology has been developed to simply and cost-effectively recover materials from disposable diapers, which currently are not recycled. The resulting WCMC mat prototypes demonstrated superior performance compared to the most commonly used commercial competitors in municipal, nursery and orchard applications.

Research and Development Opportunity

Healthy, early-stage growth of trees and agricultural plants is critical for maintaining economic stability, food production, energy savings, and environmental protection. However, delivering sufficient water and nutrients to these plants during their establishment period is increasingly complex and costly due to diminishing resources, especially for towns and municipalities across the U.S. who are engaged in urban forestry and tree planting operations while dealing with shrinking budget. Meanwhile, disposable diapers are the most disposed household products in the U.S. -- more than 2% of municipal solid waste. Re-claiming Super Absorbent Polymers (SAPs) from disposable diapers yields a new product ("WCMC" mat), which offers the only combination of water saving, weed control and extreme weather protection in one tree-irrigation package, guaranteeing healthy, early-stage growth...even in droughts. WCMC mats provide the social benefit of "More Trees, Less Waste". Faster growth and cost saving for agricultural crops offers great economic benefits to businesses.

Proof of Concept

Proof of concept was developed under previous SBIR Phase I and NSF projects. A low cost, environmentally benign recycling process for recovering SAP material from used diapers was the first major focus. In developing this recycling process, a significant drying problem was solved and reduced water retention of the recovered product by 93%. Safe discharge of water waste from the recycling process was validated by city engineers for release into normal wastewater systems. Overall discharge into the wastewater stream is proportionally low as most of the water from the separation process can be re-used. In the second major focus, prototypes were fabricated and evaluated with laboratory water distribution; systematic

bioassay tests and field trials in municipal landscaping; and orchard and nursery production. The study proved that 50% of water stored in SAP WCMC mats redistributes to plant root systems over a period of more than a month under controlled environment.

Proposed Research and Development

Proof of concept has been achieved for a low-cost, environmentally benign technology that uses SAPs from recycled diapers to produce WCMC mats. A pilot scale and a pre-production scale diaper recycling plant, combined with a WCMC mat manufacturing preproduction line, are proposed for beta-product fabrication. Pilot and production scaling will define supply chain and production processes for recyclable material collection and commercial manufacturing. WCMC mat performance will continue to be evaluated with current customers onsite at municipal landscaping, nursery and vineyard locations. A separate academic research evaluation will be conducted in collaboration with two Virginia Tech research groups that specialize in weed control and water management. Field tests within the Tobacco Commission region will be conducted with a proposed experimental and demonstration field with focuses on species that are of special interest to Tobacco Commission. Customer evaluation will also be conducted in areas with more severe drought.

Commercial Potential

WCMC mats greatly reduce the frequency of need for expensive irrigation and weed control resources. Major impact cost reductions from WCMC will benefit municipal forestry departments, landscaping, orchards, vineyards, and nurseries -- some of whom are already WCMC customers, including cities of Richmond and Ashland, Va. WCMC mats further help companies and government localities by counteracting the increasing economic challenges of climate change, enabling their plants and trees to flourish...even in harsh or neglected environments. Recently, WCMC mats outperformed the leading commercial competitor -- Tree Gator -- during a 2014 drought in Richmond, Virginia. The result: all WCMC mat trees are still alive; all Tree Gator trees are died during the drought. Mitigation of damages from other climate changes such as extreme cold and hot weathers is another important feature of this product. For the tobacco commission region, establishing agricultural businesses other than tobacco growing will diversify farmers' income.

Intellectual Foundation

Zynnovation is engaged with IP attorney Dr. John Pike (Nevrivy Patent Law Group P.L.L.C.). After review of prior IP related to WCMC domain, as well as other public literature, Zynnovation has the rights to operate with claims placed in the patent application. An international patent application (PCT/US12/56967), titled "Disposable diaper recycling and applications thereof," was filed on September 24, 2012, and the patent applications have been completed in United States, Canada and Israel on March 23, 2014, and in China on May 23, 2014. With IP protection, Zynnovation will have more freedom to pursue business development in these countries. Zynnovation's main invention is on the product, not the recycling method, which is in the public domain since late 1980s. A competitor, Knowaste Ltd has three patents related to the recycling method, in which processes were done to ensure super absorbent polymers are not absorbent anymore.

Staff comments and recommendation: *NOTE: this request was revised and reduced to $720,000 as of December 29th. See additional discussion of revisions below.* The project entails further research and demonstration of a weed control and moisture control mat for tree protection, made from recycled diapers. The proposal is for creation of a pilot scale, pre-production scale diaper recycling plant and mat manufacturing pre-production line. TICR funds are requested for 90% of equipment, 100% of property and improvements (including purchase of farmland to serve as a field test site) and 1/3 of personnel and operating costs. Given that the company is based in an incubator in Ashland VA, it is unclear how much of the operating costs would be incurred in the tobacco region, but the 1/3 share seems reasonable. Matching funds include $500k private capital yet to be raised, and $1.5 million of SBIR Phase II grants, of which $750,000 award is anticipated in April 2015; a Phase IIB award of $500,000 anticipated in April 2016, and a $232,000 Phase II

Supplemental at a later date. The proposal provides a very detailed and thorough business plan, which seems to reflect a strong scientific and business team. The proposal states that Greensville is centrally located to metro areas where diapers are in abundance such as Richmond, Hampton Roads and Raleigh, however one must question the sustainability of collecting diapers from multiple sources such as daycare centers and trucking them an hour or more to Greensville for processing. Previous NSF and SBIR funding commitments and preliminary demonstrated performance all speak to the credibility of this product concept. The company is already preparing to fill a large order for the City of Richmond, which raises the question of whether this is truly a commercialization project that should be directed to the TROF program (assuming it qualifies). Outcomes are stated as five jobs ($36k avg) and no capital investment in the research phase, with 15 jobs ($40k avg) and $100k private investment in commercialization. Ultimately this proposal seeks $3 TICR for each $1 of private capital investment, which along with the modest job creation, is clearly a poor ROI.. **Staff recommends no further action.**

Note: On January 4th Staff received a revised budget and business plan from the project leaders, reducing the request to $720,000 to focus on "investigation of pilot scale recycling process (optional), production of 1st generation of TreeDiaper (originally called prototype), and field tests in Greensville." The project leaders state their intent to focus this phase one work on activities in Greensville to develop a first generation TreeDiaper using virgin materials rather than recycled diapers. The revisions include use of sales revenues as matching funds. While these changes may have affected scoring and recommendation for vetting, Staff has not had sufficient time to review the proposed changes. The applicant will speak to the revisions at the Committee meeting.

Halifax County IDA

Development and Commercialization of an Autonomous Water Vehicle in Southern Virginia (#2981)

$1,695,314 requested

Executive summary provided by applicant: The goal of this project is to prototype and commercialize Autonomous Marine Systems' next-generation autonomous water vehicle, entitled a "Datamaran." The mission of this project is to create a robotic fleet of water vehicles that can provide customers with real-time intelligence of oceanographic data. This project will use many of the Tobacco Commission's R&D centers to design, prototype, and test the Datamarans, and will require the use of modeling and simulation, additive manufacturing, advanced manufacturing, composites, and software/network engineering. When fully commercialized, this project will bring approximately 47 high-paying, advanced-manufacturing and technical jobs to Southern Virginia.

Research and Development Opportunity

AMS' products address a need that is unfulfilled in the marine industry: inexpensive and reliable oceanographic data from remote locations that are useful for a broad spectrum of applications. The founders recognized this need from their involvement in the satellite industry where they realized that a tremendous wealth of knowledge existed in the world's oceans that could not be captured due to technology and cost limitations. A manned boat is prohibitively expensive to keep on station on the ocean for extended periods of time, so data sets are limited and locations are limited to near the coast. Drifting buoys, while cheap, are not controllable and have very low power generation. Research is needed in this sector to develop an autonomous, low-cost, low-energy, highly reliable system that can freely navigate the seas in a networking or swarming configuration and collect data for 6 months or more without maintenance or intervention.

Proof of Concept

Along with investor support, the funds from this grant will enable AMS to develop the Mark VII Datamaran. Over the last 7 years, AMS has successfully demonstrated the viability of the technology by

testing prototypes of the Mark I through Mark VI. Over 100 km have been sailed autonomously and more than 50 hours on the water have been logged. The Datamaran can sail in all wind directions and many different wind conditions. Propulsion is provided by a proprietary auto-trimming rigid wingsail augmented by an electrically-driven propeller. If capsized, the boat can automatically upright itself through a patent-pending mechanism. A low-power computer autonomously sails the boat to waypoints. The hulls, sail and keel are made of fiber-reinforced composite materials that laminate a Styrofoam core. Global communication is provided by satellite and GSM transceivers. Photovoltaic panels supply power to a lithium-ion battery pack which continuously operates all instruments and actuators.

Proposed Research and Development

To fully capture the remote data-capturing market for oceanographic data, this research aims to solve two challenges in the development of the Datamaran Mark VII: 1) Increasing the reliability of each subsystem, and 2) Developing swarming capabilities of a fleet. The first objective is to optimize the reliability of the entire system by improving each subsystem such that the Datamaran Mark VII can autonomously and reliably navigate waters for 6 months. The second goal of the research is to develop navigating capabilities and peer-to-peer communication of a self-organizing fleet. A self-organizing network enables applications such as faster data collection over larger areas, re-configurable perimeters, and tracking of fast moving objects. Datamarans capable of network functions and behaviors would allow a single operator to control a fleet of thousands of boats with a single command, greatly reducing cost of operation. Meeting these R&D aims will accelerate AMS' path to commercialization.

Commercial Potential

The oceanographic observation industry is rapidly growing and is driven by energy, food, security and environmental concerns. Over $80B is spent every year on ocean data acquisition. The low-cost nature of AMS' system means that observation and data collection can be performed where it was previously prohibitively expensive. By capturing a portion of this market, this project is projected to create approximately 47 high-skilled jobs in advanced manufacturing, software programming, and networking communication. This project will use many Tobacco-Commission-funded R&D centers for commercialization, and will strongly rely on the high-bandwidth capabilities of the MBC fiberoptic network for transport of large data sets generated by the Datamarans and communicated back to the AMS control center. AMS is already in discussion with large customers in the Energy and Defense industries who are committed to beta testing the technology for their specific data collection applications.

Intellectual Foundation

The IP of AMS is based around the utility of a lightweight, self-righting stable platform for ocean observation. AMS has one systems-level patent application in process, filed in March of 2013, which describes a self-righting sailing boat. The key of a self-righting boat is the ability to use the catamaran (1.4x as fast as a monohull) in addition to eliminating the need for ballast weight. This allows the craft to be fast, lightweight, easy to manufacture, assemble, and deploy. The patent also protects the system for automatically orienting the sail to consistently provide thrust in all wind directions without the need for tracking motors. In addition, AMS filed a provisional patent in May of 2014 regarding autonomous networks of ocean drones. The terms "Datamaran" and "Satellite for the Seas" have been trademarked. AMS's navigational code and tacking algorithms are maintained as trade secrets.

Staff comments and recommendation: The proposal seeks funds to develop a seventh-generation prototype of the unmanned, remote-controlled "Datamaran", and commercialize a robotic fleet of water vehicles, providing real-time intelligence of oceanographic data. The company is targeting the oceanographic observation industry. Proof of concept includes testing of the first six generations of prototype, patent filings and detailed design drawings were provided with application. The applicant is proposing to build out a 5,500 sq. ft. prototyping space at SVAMC, purchase equipment and tooling, hire 13 design, engineers, and assembly positions during research phases with private capital investment of $250k. Commercialization is stated at 47 jobs ($52k avg) and $1 million of private capital investment. Although the company states it

hopes to raise $4 million of equity via a Series A offering in Spring 2015. A thorough business plan provides strong evidence of the technical aspects, but lacks some detail regarding manufacturing, marketing and distribution. The plan estimates 45-50 high-skilled technical manufacturing, management, engineering, and IT related jobs during commercialization. The project budget is well-detailed and milestones/deliverables are clear. The majority of budgeted costs are split equally between TICR and matching funds, although it appears that perhaps 20% of TICR funds would be used outside the region (presumably for testing on navigable bodies of water). Given the clear technical detail in the proof of concept, apparent market share potential and the prospect for significant manufacturing employment, this proposal was tied for the third-best score during staff review. **Staff recommends this proposal be sent to vetting.**

Institute for Advanced Learning and Research
Package Innovation and Development Center (#2984)
$1,997,033 requested

Executive summary provided by applicant: Synergy Packaging Systems, LLC (SPS) is seeking funding for a Packaging Innovation and Development Center to promote a new plastic packaging technology. This technology utilizes advanced manufacturing methods to produce lower cost replacements for metal cans, glass jars, high-barrier extrusion blow molded and thermoformed containers, and rigid paper/foil laminated canisters.

Research and Development Opportunity

Synergy, with its proprietary technology, research focus will be aimed at utilizing less material, less energy and less manpower, therefore producing containers at a significantly lower manufacturing cost as well as making them more sustainable while, at the same time, making a smaller carbon footprint. In particular research will be conducted around Crystallized Polyester (CPET) which provides an outstanding barrier against both desorption of product ingredients and absorption of package materials or outside elements in the environment. Additional research will be conducted around migrating continuous vacuum forming manufacturing processes into multi-layer, high-barrier container bodies. CPET cans once developed to a commercial capability will provide a more sustainable, lower cost package to the thermally processed food packager than steel or aluminum cans. The replacement market for CPET cans exceeds 40 Billion cans annually in the US and a larger number in the European Union.

Proof of Concept

Patents issued included: (US 7,568,590; US 8,137,493; US 8,097,197, US 8,313,596 & PCT WO 2004/017375) these patents explain Synergy's bi-injection Fusion Ring Technology which is the cornerstone of the Synergy's Packaging System. System. It enables top and bottom ends to be welded to container (plastic and fiberwall) bodies via a non-contacting high energy/magnetic field. Synergy Packaging has demonstrated that all plastic cans can be produced using polypropylene based barrier composite can bodies with bi-injected polypropylene based closures and ends welded on using Synergy's patented Fusion Ring technology. CPET research and development is the next step.

Proposed Research and Development

Acquire the co-extrusion capability that allows us to research how to make the basic high-barrier tube that we are going to run into the continuous vacuum former which creates the necessary shape (can or jar). Using our proprietary technology we will produce CPET bi-injection molded closures researching how to make them "easy-opening" and "more user friendly". Additional efforts will be to ensure the 'drop-in' replacement with market will be well-received. Evaluate and manipulate tri-layer CPET based structure that minimizes modular stiffness while improving impact properties on the outer layers while maintains strength and rigidity of the center layer. Oxygen permeability and moisture vapor transmission levels will be thoroughly researched and defined.

Commercial Potential
CPET cans once developed to a commercial capability will provide a more sustainable, lower cost package to the thermally processed food packager than steel or aluminum cans. The replacement market for CPET cans exceeds 40 Billion cans annually in the US and a larger number in the European Union. Completing the development of CPET can bodies and ends is one of the goals of the development activity of this project. The goal would be for the Packaging Innovation and Development Center to employ 38 people by the end of Year 3. The long-term goal would be to establish a manufacturing facility in the footprint that would employ over 75 people by the end of Year 5.
Intellectual Foundation
Patents issued included: (US 7,568,590; US 8,137,493; US 8,097,197, US 8,313,596 & PCT WO 2004/017375). Additional intellectual property is expected to be developed.

Staff comments and recommendation: This proposal seeks funds for equipment to accomplish further development of new plastic packaging technology as replacements for metal cans, glass jars, high-barrier extrusion blow molded and thermoformed containers, and rigid/foil laminated products. Research will focus on crystallized polyethylene (CPET) which can be lower cost to steel and aluminum. Job creation during research phase is listed as 38 ($55K avg) with capital investment of $2 million. Commercialization is estimated to entail 75 manufacturing jobs ($55K avg) with $3 million investment. Matching funds will support $1.55 million of additional equipment, $450K property and improvements, and ~ $1 million for operating costs including all personnel. A thorough business plan provides strong evidence of the technical aspects, but lacks detail regarding manufacturing, marketing and distribution. the company volunteers equity in the form of stock in Synergy Packaging Systems in exchange for the Commission's financial support (p. 3 of business plan). The project budget is well-detailed (TICR funds are entirely for equipment) and milestones/deliverables are clear. Given the clear technical detail in the proof of concept, the strong industry experience of the company leaders, established patents, apparent market share potential and the potential prospects for significant manufacturing employment, this was the highest scoring proposal in the staff review. **Staff recommends this proposal be sent to vetting.**

Institute for Advanced Learning and Research
Development of High Oil Biomass (#2983)
$388,219 requested

Executive summary provided by applicant: The proposed project focuses on developing high oil biomass crops for the production of industrial chemicals and fuels. Algenetix's PhotoSeed(TM) technology has been shown to increase oil in the vegetative tissue of several crops up to 8% of the dry weight. The company is seeking to now develop this technology in high yielding biomass species such as Arundo, Miscanthus and energy cane. Oil yields per acre are forecasted to be 2MT or approximately 10x that of soybeans. At these yields, the technology creates an additional $1,000 of value per acre. End products include bio-diesel, oleochemicals, bio-coal or industrial sugars.
Research and Development Opportunity
Increasing oil in non-seed tissue has been a high value research target with limited success until PhotoSeed(TM). The world sources the majority of its plants oils through seed crops and the industry has been seeking a method to increase global production given the unprecedented demand growth. While the seed has evolved to become an efficient production system, it is a relatively small percentage of total biomass and increasing seed productivity alone simply cannot meet this demand. In contrast, producing oil in the green tissue utilizes the whole plant. Although several groups have increased oil in the vegetative tissue, the oil was transient and within weeks the oil was broken down by the cell. PhotoSeed(TM) is the

first technology to not only allow for high oil accumulation in the green tissue of plants but also its stable encapsulation (through senescence). This encapsulation is also necessary for the secondary biomass increase.

Proof of Concept

PhotoSeed(TM) has been extensively validated across several plant and microbe species. The technology to date has been successfully developed in 6 plant (alfalfa, 2 white clover species, ryegrass, Arabidopsis, and soybeans) and 2 microbe species (S. cerevisiae, Y. lipolytica). In all cases, the company showed the stable accumulation of oil in non-seed tissue and measured the presence of the associated proteins responsible for the oil increase. The overall program represents over 10 years in research and $12M in basic research funding. For more details on each experiment please see the business plan.

Proposed Research and Development

The proposed research program involves the transformation and development of PhotoSeed(TM) into high yielding biomass species. The process will involve the integration of several PhotoSeed(TM) variants into the genomes of several biomass crop species including Giant Miscanthus, Arundo donax and energy cane. Post integration, the company will select for cells containing the PhotoSeed(TM) genes and regenerate these cells into full plants. Upon successful regeneration of whole plants, the company will conduct several experiments to analyze the composition of the new plants at the glasshouse stage. Algenetix will be measuring changes to oil composition, presence of PhotoSeed(TM) protein as well as changes in carbon assimilation resulting from the oil production. Top lines from the program will be selected to go into a multiyear field trial, where Algenetix can better measure the performance of the plants in actual field conditions. A detailed development program is included in the business plan.

Commercial Potential

Algenetix has identified up to 60,000 acres of marginal land within the footprint that is suited for the production of PhotoSeed(TM) crops. At this acreage, the technology is expected to create up to 300 new jobs in the field. For farmers the higher yield of the crop could create an additional $200/acre of revenue per year. Algenetix will also be building commercial processing plants to handle the biomass. The proposed commercial plant could potentially bring in $210M in new capital investments, leading to the creation of up to 140 new jobs in the region. For further details see the business plan.

Intellectual Foundation

Algenetix is the global (ex-New Zealand) exclusive licensee for the PhotoSeed(TM) technology for biomass crops. The technology was developed by AgResearch, Ltd, New Zealand's largest Crown Research Organization, who is also the patent holder. The PhotoSeed(TM) technology is comprised of five patents across two families. The first patent family is around the modification of oleosins (oil body proteins) that allow for stable oil accumulation in non-seed tissue. The patents also cover the higher carbon assimilation. The second patent family is comprised of three patents that describe three separate proprietary modifications for DGAT1 enzymes, which the company collectively refers to as the Enhanced DGAT technology. The DGAT1 enzyme is responsible for the oil synthesis component of PhotoSeed and the three proprietary modifications improve DGAT1 enzyme activity and stability. When co-expressed the Enhanced DGAT and Cysteine Oleosin allow for maximum oil accumulation and subsequent protection. List of patents provided in business plan.

Staff comments and recommendation: This focus on increasing oil yields in biomass plants (Arundo, miscanthus, and energy cane) appears to have very solid proof of concept and several established patents to support the project, including: previous validation on alfalfa, white clover and perennial ryegrass; exclusive license for the PhotoSeed technology based on patents held by AgResearch, Ltd, New Zealand; and five patents across two families – modification of oleosins (oil body proteins) and proprietary modification for enzymes. Outcomes in research phase are three jobs and no private investment (all TICR funds appear to be requested to contract with IALR researchers to hire technicians, conduct plant propagation, manage field trials etc). Matching funds are to be committed by the company (San Diego-based Algenetix) from an anticipated Series A2 financing in Spring 2015 to pay the balance of contractual costs to

IALR for this work. The commercialization concept envisions 60,000 acres of marginal tobacco footprint land sufficient to supply a 200,000 ton per year processing facility in the region. Job creation numbers are based on an estimated 300 field management/farming related jobs growing feedstock plants, and 20 jobs created at each of seven anticipated processing plants in the tobacco region (140 total processing jobs). The company's business plan says two processing techniques are being investigated: "Alchimia super critical extraction" and torrefaction ("slow pyrolysis"). Consequently the projections for commercialization are lacking in adequate justification and details (the proposal notes they are "extrapolated from current operations" though no further detail is provided on the probability of seven tobacco region processing facilities). It is reasonable to assume that a subsequent grant request may be forthcoming to further research and demonstrate processing technologies. The business plan also describes options for commercialization and states that Algenetix and its investors "are contemplating building the first plant" but "the alternative and preferable business model is that Algenetix will license the technology package to customers and investors interested in building and operating the integrated system." The sharing of some percentage of licensing revenues with IALR is reportedly being discussed, but if the company opts for licensing over building a tobacco region plant, the terms of a grant award should require repayment of R&D funds. Given the strong foundation of patents, a well-qualified team, and some prospect for a tobacco region processing facility, this was tied for the third-highest score during staff review. Assuming adequate protections are mutually agreeable for repayment of grant funds in the event that the licensing path is chosen and a plant is not built in the region **Staff recommends this proposal be sent to vetting.**

Region 2000 Research Institute
5th Generation Nanoseptic Surfaces (#2980)
$2,000,000 requested

Executive summary provided by applicant: NanoTouch Materials invented and has successfully manufactured the first and only products in the world with surfaces that are NanoSeptic. The NanoSeptic surface continuously kills bacteria, viruses and fungi using material science and nanotechnology instead of chemicals, diluted poisons or heavy metals, and does not contribute to antimicrobial resistance (superbugs). The initial product line consists of peel & stick NanoSeptic skins for door handles and NanoSeptic mats for home, business, education and travel. With infectious disease outbreaks in the news almost daily, timing is perfect for products which provide cleaner places to touch or rest items.

Research and Development Opportunity

The first four generations of the NanoSeptic surface resulted in solid proof of concept, a fully developed initial product line, and efficacy sufficient to develop pilot sales. Research and development of our 5th generation of NanoSeptic surfaces will provide tremendous market opportunity and growth. First, if the effectiveness of the surface can consistently provide a 3-5 log reduction in microbes, additional interest will be developed in the market, and especially in healthcare, senior care and child care industries. Also, R&D focused on advanced manufacturing equipment and processes will provide a fabrication line that delivers consistent, scalable results. And finally, pursuit of EPA registration by working with our independent lab, EPA/FDA consultants and EPA staff will result in the creation of custom test protocols which could allow the NanoSeptic surface to be the first technology of its kind to be approved for health claims.

Proof of Concept

NanoTouch Materials has spent more than 3 years of research, product development, and fabrication process development, creating the first four generations of the NanoSeptic surface. These initial generations provided advancement in the following areas:

1.Generation 1 - early proof of concept utilizing basic photocatalytic technology, a woven-fabric substrate, and a residue-free adhesive.

2.Generation 2 - new advances in substrate providing a waterproof surface that can be cleaned without affecting the print or efficacy
3.Generation 3 - addition of compatible non-adhesive backed substrates to serve as mats and portable applications
4.Generation 4 - advances in primers, protective coatings, and fabrication techniques to improve durability and functional life

Proposed Research and Development

1. Research the effect of doping the current nanotechnology with new elements. Research new primers that enhance the efficacy of the nanotechnology and durability in various environments.
2.Develop and implement advanced manufacturing processes, equipment and automation for fabrication of the new and improved material science and technology (see #1 above). Add employees with an increasing demand on higher-skilled labor to execute necessary tasks due to process automation and proprietary processes.
3.Conduct iterative testing throughout the research and development process to provide constant guidance and improvement. And conduct verification tests which can be published, influencing purchasing decisions in each of our target markets.
4.Advance the state of photocatalytic technology to provide increased efficacy, improved low-light performance, and the development of a "healthcare grade" surface by doping the nanotechnology with various additives. This would be the first surface of its kind to seek EPA approval to make health claims.

Commercial Potential

While there is obvious potential for sales in the US, NanoSeptic products have great potential to improve public health worldwide. In 2014, four press releases resulted in web traffic and distributor inquiries from more than 60 countries. To date, NanoTouch Materials has signed distribution agreements in 22 countries outside the US. Just three of these agreements have resulted in the receipt of $140,000 in deposits and almost $3.5M in projected purchases over the next 2 ½ years. Because NanoSeptic products have a low retail price of $1 to $25, they cross most demographic barriers. Because they are simple to use and their function is easy to understand, they cross cultural barriers. People universally want to live in a healthier environment and avoid infectious diseases, and NanoTouch can help provide that benefit, concurrently delivering tax, employment and capital investment growth within the region.

Intellectual Foundation

NanoTouch filed a provisional patent application in December of 2011 and followed up with a final utility patent application a year later. Representative Goodlatte's office did reach out to the PTO on our behalf to get a status update, and the first office action is expected sometime around mid-2015. The patent application was written with additional innovation in mind. With approval of the current patent application, NanoTouch will be free to adjust ingredients and antimicrobial technology, along with primers, coatings, substrates and adhesives. NanoTouch also successfully registered the trademarks NanoTouch and NanoSeptic. The term NanoSeptic will be marketed to become the "Xerox" or industry standard in self-cleaning surfaces.

Staff comments and recommendation: Funds are requested to assist the private beneficiary, which currently is housed at CAER, in developing its fifth generation product. Products are targeted to the health care, senior care, and child care industries to include travel mats for hospitality industry and business traveler, snack mats for education, counter mats for reception desks, place mats for food service, etc. Patent documents were filed in December 2011, with action expected in mid-2015. Research involves adjusting ingredients and antimicrobial technology, and further researching primers, coatings, substrates, and adhesives. Funds will be used to develop a fabrication unit for consistent and scalable product production. Funds are specifically requested for personnel ($995k), contractual ($265k), continuous ($242k), equipment ($165k), property/plant ($222k), materials ($110k) etc. It appears that as much as half or more of the request may be for company operations that are not R&D funding priorities, such as customer service, order

fulfillment, sales/marketing, and to fund nearly 80% of the construction of a new production facility for the company in the New London technology park. A strong business plan is provided, with the notable lack of detail on production/manufacturing expenses. The applicant provides evidence of the commitment of matching funds from a bank and corporate investor. Outcomes are listed as 12 jobs ($50k avg) and $850k private investment in the research phase. Commercialization outcomes are listed as 37 jobs ($36k avg). No commercialization phase private investment is listed. While this proposal ranked 2nd in scoring due to clear proof of concept and prototypes, committed matching funds, and creation of new jobs, Staff believes the budget can be reduced significantly to focus on the necessary research steps. While further budget negotiation is conducted by TICR staff and the project leaders, **Staff recommends this proposal be sent to vetting.**

Region 2000 Research Institute
Critical Communications Voice & Data Interchange System (CCVDIS) (#2979)
$904,372 requested

Executive summary provided by applicant: Public safety officials need better tools to detect and respond to manmade and natural disasters. One critical tool is communications. Traditionally officials have used two-way radios for this critical function. These systems provide robust voice communications but can only support very slow data transfers. Catalyst plans to develop a scalable, multi-vendor, multi-message type, cost-effective solution, providing advanced connectivity between incompatible technologies, as well as emerging applications for commercial devices, allowing officials to leverage the speed and flexibility of these new platforms. The result is better communications across large geographic areas and faster access to essential information.

Research and Development Opportunity

Catalyst will leverage existing software applications and a proof of concept Smart Phone interface to create a voice and data interchange system (VADIS) that links commercial and consumer networks together. This augmentation of commercial communication networks with consumer networks will create an integrated environment where applications such as voice, texting, and location can freely be retrieved and sent to each subsystem without regard to the technology of the ultimate destination. To accomplish this ambitious goal, Catalyst must:

1)Develop a full featured wireline interface to the most prevalent critical communications systems being deployed in the US today: P25 and DMR.

2)Develop a full featured interface to Smart Phones on LTE and other data networks.

3)Leverage its existing full featured interfaces to the most prevalent critical communications systems deployed.

4)Exploit this access to disparate systems in innovative ways to integrate and expand inter-technology capabilities

Proof of Concept

Catalyst has developed and implemented several generations of products, briefly classified as follows:

- 1st Generation -- Supplementary Backup Dispatch -- Catalyst's systems were used for situations where the primary dispatch system was offline or down for maintenance.
- 2nd Generation -- Interoperability -- Catalyst's system provided a bridge between disparate radio systems.
- 3rd Generation -- Wireless Primary Dispatch -- Catalyst's system provides primary dispatch capability using primarily wireless technology also known as control station interfaces.
- 4th Generation -- Wireline Primary Dispatch -- Catalyst's system provides primary dispatch capability using wireline technology that connects directly to radio system infrastructure.

Today 3rd Generation systems are shipping, and 4th Generation systems are well past the proof of concept stage with several wireline products with basic functionality in operation. This project will develop the features and improvements required for full commercialization of our 4th Generation Products.

Proposed Research and Development

The features and improvements required for full commercialization of 4th Generation Products include:

- Scalability
  - Integrate the software codec and create new management tools for handling many virtual channels (called Talkgroups) and dynamically addressing server load sharing.
- Eliminate the hardware associated with control station wireless interfaces
  - dongles, donor radios, cabling, signal conditioning hardware, antennas, and power supplies.
  - equipment room space requirements for control station hardware.
  - the expense and complex logistics of adding towers and outside antennas for donor radios.
- Add features readily available through Wireline interfaces
  - P25 Console Subsystem Interface (CSSI) - Location (GPS), Text Messaging, Individual call, Cross patch and Console pre-emption
  - DMR Application Interface Specification (AIS) -- Emergency, Text Messaging, Individual call, and Console pre-emption
  - LTE - PTT Voice, Text Messaging, Location (GPS), and Group calls
- Gain installation experience with wireline interfaces in the field

Commercial Potential

Catalyst projects an increase in sales revenue of $9.5M for these systems, including services and applications, in the 2015-2018 period. Catalyst will increase their workforce in the region by 58%, from a current level of 15 to 22. We projected that additional in-region jobs will be supported by the open standard applications interface that Catalyst creates through this project. Catalyst's laboratory in the region could be used to certify open standard applications for use with P25 and DMR interfaces. The cost of the equipment to test these interfaces is a barrier to entry for many independent applications providers. Catalyst will increase wages and benefits paid to Catalyst personnel in the region including the additional jobs listed above and increased compensation for current personnel by $1M per year by 2018. Catalyst will purchase $100K in additional equipment and other assets that will enable and support commercialization of the systems by 2018.

Intellectual Foundation

Catalyst installed the first Radio over Internet Protocol (RoIP) dispatch console at what is now American Electric Power in 1999. Since that time it has been creating new technology, enhancing its product line, and installing systems across the United States and internationally. The company fielded the first Project 25 Fixed Station Interface-based console in 2006. Catalyst installed the first broadband (3G) PTT interoperability & dispatch solution in 2009 and currently has that product operating in the field. Verizon Wireless chose Catalyst as a Business Solutions Partner for PTT and the companies continue to collaborate as Verizon moves to 4G PTT. Catalyst fielded the first intelligent interoperability solution between the emerging Digital Mobile Radio (DMR) and legacy Motorola trunking system, SmartNet, in 2013. The innovations envisioned in this project are understood by Catalyst's engineers and marketers as logical next steps in the commercialization of its next generation product line.

Staff comments and recommendation: The private beneficiary, Catalyst Communications, also benefitted from a Special Projects grant in FY12 for $348k that provided test equipment for CAER and its telecommunications research focus. The majority of TICR funds are requested for personnel ($712k), as well as equipment ($150k), contractual and supplies. Job creation during research is listed as seven ($50k avg) with $50,000 private investment. Commercialization outcomes include seven jobs, which appear to be the same seven as in research (the proposal states an increase from 15 current jobs to 22). TICR funds appear to be supporting existing staff, and the majority of new jobs are identified as operations positions. Staff has inquired about the general role for these positions (i.e. production technicians, administration,

finance?). Detailed budget is only at budget category level and insufficient for evaluating use of funds. The budget for TICR funds is not well-detailed, and matching funds status is extremely vague and suggests that further project development is needed (e.g. in-kind match is described as from "several potential customers and providers of complementary products and services"). Staff has inquired as to how Catalyst currently handles production of equipment and their production capacity. While Catalyst is an established high tech small business in Region 2000, the commercialization outcomes are very limited, and lacking solid prospects for required matching funds and significant ROI, **Staff recommends no further action.**

Southwest Virginia Higher Education Center Foundation
Smart Packaging and Predictive Analytics to Reduce Abuse of Prescription Opioids (#2985)
$375,000 requested

Executive summary provided by applicant: Vatex is developing a combination of smart packaging and predictive analytics to monitor patient access to individual doses of medications and make behavioral assessments from the data. The application will combat the abuse and trafficking of prescription painkillers and other medications with street value, a national problem particularly prevalent in Southwest Virginia. The data generated by the integrated system, "Divert-X," will enable evidence-based intervention by healthcare providers and law enforcement resulting in improved patient outcomes and reduced healthcare costs. The Foundation seeks funding for Vatex to complete the engineering and assembly of the Divert-X hardware, integrated software and behavioral algorithms.

Research and Development Opportunity

Behavioral science has been shown to be successful in influencing consumers in non-medical environments such as in credit-risk and gambling assessments. We will translate this approach to patient medication use monitoring. The examination of patient drug access data has been used to evaluate and promote medication adherence, but not previously to combat the epidemic of prescription drug abuse. Divert-X is expected to impact the problem on many levels: generating early warning of addiction; reducing the excess medical costs that are consequential to abuse. A smart packaging approach has been documented to be of strong interest to the FDA.

Proof of Concept

Smart blister packs have been evaluated in a small clinical trial to monitor adherence to buprenorphine patients (an opioid maintenance treatment) and generated a 39% reduction in patient care cost. Eighty-six percent of buprenorphine patients polled for Vatex said that such a device would reduce opioid drug diversion. Patients who became addicted to painkillers after initial legitimate medical use unanimously agreed our technology would have prevented them from developing a lifetime of addiction. Detailed product development planning is in place and confirms that the long term cost of the Divert-X components is consistent with the product value proposition and pricing model.

Proposed Research and Development

Prototypes of a child proof blister will be fabricated and tested in child test-subject panels to certify the safety of the medication containers. This step is essential to the commercialization of Divert-X. The engineering design and initial manufacturing run of the wireless transmitters will be funded by the project. Vatex will develop the software, cloud infrastructure, wireless communication method and fully integrate the system. A beta test of Divert-X will be conducted to de-bug the product prior to clinical evaluation. These steps will result in a subsequent evaluation of Divert-X in SW Virginia.

Commercial Potential

Prescription drug abuse is a problem not just for southwest Virginia, but for the entire Commonwealth, and the whole country. It is a problem of health, public safety, and economic development. Business cannot

thrive if they cannot find drug-free workers are high, and people cannot be hired if they abuse opioid drugs. Divert-X should be standard-use for the dispensing of all Controlled Substances. There are more than 500MM prescriptions/year for painkillers, anti-anxiety and anti-depressant medications in the US. After this R&D project a clinical evaluation of Divert-X will be conducted to quantify the economic and health benefits generated by the system. This data will be used to facilitate adoption of the system by medical insurers. Vatex will be headquartered in the Tobacco Region and will add personnel as corporate infrastructure is built. We have identified regional supply chain partners, which should generate additional regional employment growth.

Intellectual Foundation

Vatex has a US patent pending, application 13/312956 filed December 6, 2011, covering the basis of the Divert-X innovation. Inventor is James Harris, Vatex's Chief Science Officer. A provisional patent has also been filed covering the engineering design of an important aspect of the smart blister-pack. Vatex has sole ownership of both patent initiatives. "Divert-X" is a registered trademark.

Staff comments and recommendation: The private beneficiary, Vatex Explorations LLC, is operated by two principals based in Texas and Illinois. Vatex applied to the Commission twice in 2012 for the Divert-X project, and the R&D Committee declined to recommend vetting or funding. Funds are requested for personnel ($215k), supplies ($150k) and other operational costs to create five prototype units for testing and 1-3 optional prototypes of child-proof blister packet drug packaging. A business plan that was submitted with the proposal indicates plans to then conduct a behavioral study with field tests on 50 patients and a pilot project. The budget appears to show $2.6 million costs through pilot project stages (not just the $750K sought in this proposal), suggesting this will require future support from TICR. The primary target audience is insurance companies; but there is no evidence of their willingness to pay the projected product cost of $45/unit (or $35/unit at higher volume). Patent applications filed in 2011 have not yet been ruled upon. Outcomes are listed as three jobs ($60k avg) in the research phase with no capital investment. It appears two of the jobs may be the company's current principals, and it is not clear if TICR funds would be spent in the region. Commercialization outcomes are shown as 60 jobs ($60k avg) with a $2 million private investment, although the business plan states that the company "will be attractive to a broad category of potential acquirers" so the probability for commercial stage job creation and investment within the tobacco region is questionable at best. It also appears that despite what would seem to be a significant public and private interest in combating prescription drug abuse, the company has not yet been successful in securing any federal or corporate commitments to fund research to develop this product (the proposal does not indicate that any new investments or progress has been made to establish DivertX since the 2012 R&D requests). Consequently, matching fund sources are not known, and the Committee must decide if it chooses to commit funds as a "first-dollar" investor in this product. Given the lack of committed matching funds, approved patents and potential exit strategies for the company **Staff recommends no further action.**

Southwest Virginia Higher Education Center Foundation

Low cost, high pressure, hydrogen storage vessel using steel wire overwrap (WireTough Phase 2) (#2982)

$2,000,000 requested

Executive summary provided by applicant: WireTough successfully completed a Phase 1 TIC award. It has grown sales from zero to cash flow positive. Recently the DOE awarded $2MM to WireTough to develop the hydrogen storage cylinders. WireTough wishes to conduct applied R&D to expand on its

existing technology platform. WireTough intends to make cylinders that (1) hold gases at much higher pressures -- up to 13,000 PSI and (2) are substantially larger in volume than cylinders in WireTough's current product line. These cylinders will be sold for storage of natural gas and hydrogen at fueling stations, and for transporting large volumes of gas.

Research and Development Opportunity

There is an opportunity to use WireTough's Virginia-made products as the platform for storing hydrogen and natural gas at high pressure and high volumes. This work will require nearly quadrupling the pressure at which WireTough's cylinders can store gas, and increasing their size. Necessary to achieve this is a source of larger cylinders (Russell County supplier), certification of the larger cylinders, adaption of higher strength steel wire previously invented in part by WireTough's CEO, and study of the effects of hydrogen on liners and steel wire wrapping steel compositions. The DOE is contributing a $2MM grant to WireTough to partially fund this effort.

Proof of Concept

The proof of concept of wrapping high strength wires on low alloy steel liner has mostly been proved by WireTough's Phase 1 project, and the company's successful entry into the Compressed Natural Gas (CNG) cylinder market at 3600 PSI. We have successfully made cylinders for up to 5000 PSI. 13000 PSI is achievable with our current capabilities and adequate funding.

Proposed Research and Development

Modify existing production machine to work with larger cylinders. Obtain ASME certification for 5000 PSI (pounds per square inch) stationary storage cylinders. Produce and manufacture high pressure (13000 PSI) and high volume storage cylinders. Optimize manufacturing process, including steel wire creel set up for larger cylinders, wrapping process, application of epoxy, and curing.

Commercial Potential

By being able to produce the highest pressure cylinders at the lowest cost, WireTough will garner the lion's share of the multi-billion dollar market for high pressure storage of natural gas, hydrogen and other gases. See business plan for more details.

Intellectual Foundation

The process is proprietary and two US patents are pending. Wiretough has been manufacturing these tanks for the storage of CNG on-board a vehicle for last 3 years. Certain processes, for example curing and finishing are proprietary and has given the company advantage on quality and performance.

Staff comments and recommendation: The SVHEC Foundation and WireTough received a phase one grant of $521k in 2010 that was critical in securing in mid-2014 a USDOE grant of $2 million that is underway and will serve as the majority of the required matching funds. WireTough also states it will invest $750k of its own funds in operations and facility. Funds are requested in this second phase for personnel ($700k), materials ($495k), equipment ($375k), site improvements ($280k) and contractual ($150k). Outcomes are listed as five jobs ($60k avg) and $3 million private investment in this second research phase, and 30 jobs ($60k avg) with $5 million private investment during commercialization. Outcomes appear to overlap with the initial R&D grant as the two research phases collectively lead to commercialization. A 20,000 square foot expansion is budgeted at $240K. If funding is approved, the question of whether this would be done at the company's current leased space or at an alternate site must be addressed cautiously. The proposal clearly states defined products and markets that are complementary to the DOE-funded research, and the company's success in securing DOE supports validates the technology that is under development. Based on the company's progress in developing its technology, securing substantial federal matching funds, and the potential for significant commercialization employment and investment **Staff recommends this proposal be sent to vetting.**

Washington County Industrial Development Authority
Hermetically Sealed Epoxy Power Terminal for Electrical Equipment (#2977)
$722,590 requested

Executive summary provided by applicant: Bristol Compressors has manufactured air conditioning, heat pump, and refrigeration compressors for over 40 years utilizing a standard hermetic power terminal commonly referred to as a "Fusite". Bristol Compressors has now developed a proprietary and patented epoxy power terminal that improves the power terminal in multiple ways. The new epoxy terminal would allow Bristol Compressors an opportunity to market & sell a unique product for OE and aftermarket customers.

Research and Development Opportunity

The new epoxy power terminal has been developed through initial concept and preliminary design. The project will allow Bristol Compressors to complete full design, reliability, and most importantly final UL (Underwriter Laboratory) approvals to allow the use of the epoxy power terminal in commercial and residential products. The final product design, samples, leak testing, electrical testing, reliability testing, and agency testing requires significant product expense and engineering time to provide the necessary data that supports customer and UL approvals. The HVAC industry complies to very strict test standards and protocols which drives the requirement to complete very specific and detailed testing. The market need for this development was recognized from the movement toward higher energy efficiency levels, future required reduction in refrigerant global warming potential numbers leading to the increased use of A2L (mildly flammable) and A3 (highly flammable) refrigerants, and to improve the electrical safety of energized equipment.

Proof of Concept

The epoxy power terminal has fully detailed design drawings, produced prototype samples, and extensive proof of concept testing that validated the current carrying capability, hermetic sealing capability, and pressurized strength capability of the device. The product concept was filed with the USPTO, and Bristol Compressors received patent approval. The power terminal was resistance welded into actual compressor housings where the hermetic seal integrity was checked by pressurization of the entire welded compressor housing using specialized leak detection equipment. The compressor underwent electrical performance checks of the device.

Proposed Research and Development

The proposed project will complete all required product tests to obtain customer and UL approvals, and to pass all Bristol compressor required reliability tests. After completion of the project Bristol Compressors would be allowed to sell compressors into the commercial market bearing the UL trademark of approval. The company's customers would then be in a position to test our new compressors in their systems to achieve system UL approval for commercialization.

Commercial Potential

The maximum commercial potential for this project would uniquely position Bristol Compressors to grow market share in refrigeration applications, aftermarket sales, and new flammable refrigerant applications. In addition to our ability to have a unique product for growth within our current compressor business, we would also be able to license the IP and/or sell the device itself to all Global compressor companies. The global market for compressors sales exceeds 40 million annual units. This would create an entirely new revenue stream and market potential for Bristol Compressors. The market growth of the device would be a substantial opportunity for expansion of the company's manufacturing capabilities to produce the device with all associated process equipment and labor.

Intellectual Foundation

The device has received USPTO patents, application # 11/894,110, and has been filed as an international PCT application US2008/009434 for global marketplace protection. Additional patents and IP claims will be filed as new development testing reveals additional design inventions and product application opportunities.

Staff comments and recommendation: The IDA and Bristol Compressors were approved for a $808k R&D grant in May 2014 to test flammable refrigerants for its compressors. This development of a sealed power terminal appears to be one of several additional research tasks as BCI complies with the federally-mandated move to alternative refrigerants. Patent documents for the sealed power terminal were filed in 2007 and published in 2009. The company has indicated that other compressor components will also be researched as part of that move, although those are not identified at this time. Funds are requested for personnel ($352k), contractual ($201k) and materials ($170k). Matching funds are shown as the company's on-hand investment in like amounts in the same three budget categories. Outcomes are listed as 4 jobs (new technical hires) and no private investment in research stage, and 50 jobs ($50k avg) and $1.8 million investment during commercialization. The power terminals (if approved) would be manufactured by BCI (6 new hires for manufacturing the terminals are anticipated in the business plan). Outcomes appear to overlap with the initial R&D grant as the two research phases collectively lead to UL approvals and commercialization. As in the Floyd request, this is a company that is long-established in the footprint, conducting ongoing product development for its core line of business. Whether that is an appropriate process for the R&D program to support – as opposed to using grant funds as an incentive to attract new companies - is a key question. It also appears that future funding requests may be forthcoming to research other aspects of a flammable refrigerant compressor. This request tied for seventh in scoring, receiving solid points for an established patent, presence in the region and private investment during commercialization, but fewer points for the limited jobs in production of the terminals. Staff suggests this be resubmitted at a future date in conjunction with additional identified research tasks for the refrigerant conversion process. **Staff recommends no further action.**